

SECTION 713 MISCELLANEOUS MATERIALS

713.01 WATER. Furnish water for mixing and curing concrete that meets AASHTO M 157, 4.1.4 requirements. Water will be tested under AASHTO T 26. Known potable water may be used without testing.

Use irrigation quality water for irrigating trees, plants, and seeded areas, free of elements harmful to plant growth.

713.02 HYDRATED LIME. Furnish hydrated lime meeting AASHTO M 303 requirements. Use Type II lime or use Type I in increased quantity to provide the required total calcium and magnesium oxides.

713.03 CALCIUM CHLORIDE. Furnish calcium chloride meeting AASHTO M 144 requirements.

713.04 CEMENT GROUT. Produce grout consisting of 1 part portland cement to 3 parts of sand thoroughly mixed with water to produce a uniform thick mortar. Use mortar within 30 minutes of adding water. Mortar cannot be re-tempered.

Use sand for mortar meeting Subsection 701.01.1 and Table 713-1 gradation requirements.

TABLE 713-1

MORTAR SAND GRADATION REQUIREMENTS	
Passing a No.4 Sieve (4.75 mm)	100%
Passing a No.8 Sieve (2.36 mm)	90-100%
Passing a No.16 Sieve (1.18 mm)	60-90%
Passing a No.50 Sieve (0.300 mm)	15-40%
Passing a No.100 Sieve (0.150 mm)	0-10%

713.05 TOPSOIL. Furnish topsoil meeting Table 713-2 gradation requirements.

**TABLE 713-2
TOPSOIL GRADATION REQUIREMENTS**

FRACTION	PARTICLE SIZE (mm)	MAX. % OF SOIL (-10 MESH) (2MM) FRACTION
Sand	0.05 - 2.0	85
Silt	0.005 - 0.05	80
Clay	Less than 0.005	50
Gravel	Larger than 2.0	* Max. % of Total Sample

* A maximum of 20% is allowable. Any quantity exceeding 10% is not included in the basis for payment. Gradation is tested under AASHTO T 88.

Meet the following:

1. Soil pH between 5.5 and 8.0 or up to 8.5 if the exchangeable sodium is less than 10 percent;
2. Soil conductivity factor less than 4;
3. Organic content between 1% to 20%.

Topsoil is sampled and tested under Montana Test Method MT-412.

713.06 MINERAL FILLER. Mineral filler is portland cement, ground limestone dust, fly ash, or graded fines free of silt or clay produced from crushing stone, gravel, slag, or other non-plastic mineral matter. Mineral filler and their sources are subject to the Project Manager's approval.

Furnish mineral filler meeting Table 713-3 gradation requirements when tested under MT-301.

**TABLE 713-3
MINERAL FILLER GRADATIONS**

SIEVES	TOTAL PERCENT PASSING
No. 30 (0.600 mm)	98-100%
No. 80 (0.180 mm)	95-100%
No. 200 (0.075 mm)	65-100%

Meet the following:

1. Dry and free from fine particle lumps;
2. Free carbon less than or equal to 5% by weight as measured by the loss on ignition test;
3. Silica content less than or equal to 10% for un-calcined materials.

AASHTO T 165, T 167, and Montana Test Method MT-306 or other tests may be used to determine the need for mineral fillers.

713.07 CONCRETE CURING AND PROTECTIVE COATINGS.

713.07.1 Water-Soluble or Emulsified Liquid Membrane-Forming Linseed Oil Compounds. Furnish water-soluble or emulsified liquid membrane-forming linseed oil compounds meeting AASHTO M 148 requirements. Linseed oil compounds, when used as a protective coat must contain a minimum 2.7 pounds (0.32 kg) of linseed oil per gallon (liter).

Furnish a manufacturers written certification to the Project Manager showing the formulated weight of linseed oil per gallon (liter) meets or exceeds this limit.

713.07.2 Miscellaneous Combination Curing and Protective Coating Compounds. Obtain the Project Manager's written approval before using a commercial product.

Meet AASHTO M 148 requirements for a liquid membrane-forming compound for curing concrete.

713.07.3 Membrane Curing Compounds. Use membrane curing compounds meeting AASHTO M 148 requirements.

713.08 SEED.

713.08.1 Grass Seed. Furnish all seed that meets and is labeled under Montana Seed Law and meeting the Contract requirements.

Furnish seed originating from the North American Continent above 41 degrees latitude. Make written request for waivers of the above requirements to the Department Agronomist.

Furnish seed free of prohibited noxious weed seed with restricted weed seed not exceeding Montana Seed Law.

Wet, moldy, or otherwise damaged seed will be rejected.

Calculations of "pure live seed" may be made based on either a germination test or a tetrazolium test, in addition to the purity analysis.

Furnish the Project Manager a purity analysis and germination test of the seed proposed for use. A germination test must have been performed within 12 months of the seeding date.

Apply seed on a "pure live seed" basis. The quantity of "pure live seed" per 100 pounds (45.4 kg) of seed is determined as follows:

% "Pure live seed" = Germination % X Purity X 100

Bulk Seed needed = Total lbs. pure live seed required ÷ % Pure live seed X 100

Notify the Project Manager in writing of the seed source and the approximate date the seeding will begin. Submit the notification at least 6 weeks before seeding begins. Do not begin seeding until the germination and purity test results are known.

Make each species of seed available in separate bags for sampling and inspection.

713.08.2 Legume Seed. Meet Subsection 713.08.1 requirements for source, grade, purity, germination, and "live seed" definition. Use the inoculant's specified in the Contract when seeding legumes.

713.09 FERTILIZER. Use commercially manufactured fertilizer meeting the Contract requirements.

The fertilizer must be labeled with the manufacturer's guaranteed analysis, meeting Montana fertilizer laws.

Contaminated or damaged fertilizer will be rejected.

Apply fertilizer at the rate specified in the Contract.

713.10 MULCH.

713.10.1 Vegetative Mulch. Vegetative mulch is pliable cereal grain straw or grass hay at least 8-inches (205 mm) in length.

Mulch will be rejected for the following reasons:

1. Chopped or ground mulch;
2. Mulch that is musty, moldy, rotted, or contains noxious weed or grass seed-bearing stalks;
3. Mulch containing stones, dirt, roots, stumps, and other foreign material.

713.10.2 VACANT.

713.10.3 Fabricated Netting. Fabricated netting is composed of burlap, kraft paper string, or similar products and may be fabricated on the project.

Submit samples for testing and approval before use.

713.10.4 Wood Cellulose Fiber Mulch. Wood cellulose fiber mulch is specially prepared wood cellulose fibers free of growth or germination inhibiting materials that forms a homogeneous slurry when combined with water, fertilizer, and other approved additives and remains uniformly suspended under agitation. Color the mulch with a water-soluble, nontoxic dye to aide visual metering during application. Apply the mulch to produce a mat-like cover on the seeded ground.

At least 30 percent of the mulch fibers must average 0.15- inches (4 mm) or longer with 50 percent or more retained on a Clark Fiber Classifier 24-mesh screen.

Furnish wood cellulose fiber mulch meeting Table 713-5 requirements.

**TABLE 713-5
WOOD CELLULOSE FIBER MULCH
PHYSICAL AND CHEMICAL PROPERTIES**

PROPERTY	LIMIT	TOLERANCE
Moisture Content (total wt basis)	12%	± 3%
Organic Matter (oven-dried wt basis)	99.2%	± 0.2%
Inorganic Content (Ash)	0.8%	± 0.2%
Min. Water-holding Capacity (oven-dried wt basis)	1080 g/minute	100 g/minute

Supply the mulch in 50 pound (22.7 kg) bags net weight. Each bag must be marked by the manufacturer showing the air-dry weight content.

Supply a minimum one pound (0.454 kg) bag of the mulch proposed for use for testing when requested.

Provide a manufacturer's certificate of compliance under Subsection 106.03, attesting that the material meets these specifications.

713.10.5 Recycled Paper Fiber Mulch. Recycled paper fiber mulch is waste paper of at least 85% by weight, cellulose fiber. The mulch must:

1. Not contain any germination or growth inhibiting material nor non-biodegradable material;
2. Contain at least 95% organic matter (ovendry) when tested under ASTM D 586;
3. Have a pH of between 5.5 and 7.5;
4. Supplied in the manufacturers packages, clearly marked showing the package weight and contents;
5. Packaged mulch moisture content cannot exceed 15% by weight.

The mulch, when mixed with water and fertilizer and agitated, must be a uniform, homogenous mixture. The mulch or slurry must contain a green non-toxic dye making the mulch clearly visible once applied.

Apply the mulch hydraulically to form a moisture retaining surface that holds the seed in contact with the ground without smothering the seed.

713.11 SOD. Furnish sod that is a living, vigorous growth of grass of the type and thickness specified.

Provide sod native to the general locality of the project, having a dense root system, is free of noxious weeds, noxious grasses, and other foreign substances harmful to the development and maintenance of the sod.

Cut the sod when the grass length is approximately 2-inches (50 mm) high but not exceeding 3-inches (75 mm). Assure the sod is free of debris before cutting.

Wet the sod to permit cutting, rolling, and hauling without crumbling or breaking.

Water the sod using water from a municipal, domestic, or other source suitable for irrigation.

713.12 SOIL RETENTION/EROSION CONTROL BLANKETS AND MATS.**713.12.1 Wood Excelsior Fiber Blankets.**

Type EX 1. Type EX 1 wood excelsior fiber blanket is a machine produced mat uniform in thickness and weighing at least 1 pound per square yard (545 g per m²). The top side of the blanket must be covered with a photo-degradable extruded plastic mesh netting.

Type EX 2. Furnish Type EX 2 wood excelsior fiber blankets meeting the requirements of Type EX 1. Sandwich blankets between a high strength extruded plastic mesh netting.

Type EX 3. Type EX 3 wood excelsior fiber blanket is a machine produced mat of cured wood excelsior meeting the following requirements:

1. Minimum weight of 1.6 pounds per square yard (86 g per m²);
2. Minimum width of 36-inches (915 mm);
3. Minimum roll length of 80 feet (24.4 m);
4. Eighty percent of the wood fibers must be at least 6-inches (155 mm) long, evenly distributed throughout the mat;
5. Encased top and bottom with a high strength plastic mesh netting that resists ultraviolet breakdown.

713.12.2 Straw Blankets.

Type ST 1. Type ST 1 straw blanket is a machine produced mat:

1. Made from 100% clean agricultural straw weighing a minimum 0.50 pounds per square yard (270 g per m²) with a uniform thickness throughout the blanket;
2. The top side covered with a lightweight photo-degradable polypropylene net weighing approximately 1 pound per 1000 square feet (488 g per 100 m²).

Type ST 2. Type ST 2 straw blanket meets Type ST 1 requirements and the following:

1. Sandwiched between a top cover of heavyweight UV resistant polypropylene netting weighing approximately 3 pounds per 1000 square feet (1,460 g per 100 m²) and on the bottom cover of a lightweight photo-degradable polypropylene netting weighing approximately 1 pound per 1000 square feet (485 g per 100 m²).

Type STC. Furnish Type STC blanket that is a machine produced mat:

1. Of 70% agricultural straw weighing 0.35 pounds per square yard (190 g per m²) and 30% coconut fiber weighing 0.15 pounds per square yard (82 g per 100 m²).
2. Having a uniform thickness with the straw and coconut evenly distributed within the mat.
3. Be sandwiched between a top heavy weight, UV resistant polypropylene netting weighing approximately 3 pounds per 1000 square feet (1460 g per

100 m²) and the bottom being a lightweight photo-degradable polypropylene netting weighing approximately 1 pound per 1000 square feet (485 g per 100 m²).

4. Sewn together with durable thread.
5. Treated to sterilize all weed seed.

Provide the Project Manager a manufacturer's certification stating the blankets supplied for the project have been sterilized and a statement detailing the method of sterilization used, before the blanket is installed on the project.

713.12.3 JUTE MAT. Type JUTE mat must be:

1. New unbleached jute yarn, uniformly open weaved.
2. Loose twisted yarn not varying in thickness by more than one half its nominal diameter.
3. Having a minimum yarn warp count of 78 per width and a minimum weft of 41 per linear yard (0.9 m).
4. Weighing 0.92 pounds per square yard (500 g per m²) (untreated) and 0.97 pounds per square yard (528 g per m²), treated to be smolder resistant.

713.12.4 COCONUT MAT AND BLANKETS.

A. Type C Coconut Mat. Type C mat is:

1. Coconut mat made of 100% coconut fiber woven into a high strength matrix.
2. Has a minimum weight of 0.8 pounds per square yard (0.43 kg /m²).

B. Coconut Blanket. Coconut Blanket is:

1. A 100% coconut fiber matrix sewn between two heavyweight UV stabilized nets.
2. Weighing a minimum 0.5 pounds per square yard (0.27 kg/m²).

713.12.5 Synthetic Polypropylene Mesh. Furnish a mesh made from polypropylene fibers spun in one direction and meeting the following:

1. Beige or Natural in color;
2. Minimum weight measured under ASTM D 3776 of 2.25 oz/yd² (76 g/m²);
3. Tensile strength measured under ASTM D 4632 of 225 X 120 lb/ft (3280 X 1750 N/m);
4. Elongation at break measured under ASTM D 1682 of 32 percent by 40 percent;
5. Mullen burst strength measured under ASTM D 3786 of 120 psi (827 kPa).

713.12.6 Polypropylene Roving. Furnish polypropylene roving from continuous strands of fibrillated polypropylene yarn. Wind the roving into a cylindrical package so the roving can be continuously fed from outside of the package through a compressed air injector and expanded into a mat of polypropylene strands. The material must not contain agents toxic to plant or animal life and meet the following requirements:

1. Contain 20 to 28 strands per rove measured by end count;
2. Have a fiber diameter, denier of 360, by calculation;
3. Rove of 170-515 yards per pound (340-1050 km/kg) (ASTM D 1907);

4. Strand of 12,400 to 14,000 yards per pound (25-28.2 km/kg) (ASTM D 1907);
5. A maximum 1 percent organic content (ASTM D 1907);
6. A package weight of 18 to 25 pounds (8-11 kg).

713.12.7 Synthetic Erosion Control and Revegetation Mat. Furnish a flexible mat of polyolefin monofilament fibers positioned between 2 biaxially oriented nets and mechanically bound together by parallel stitching with polyolefin thread to form a 3 dimensional web-like weave, highly resistant to environmental and chemical deterioration, and meeting the following:

1. Green in color;
2. Minimum mat thickness of 0.125-inch (3 mm) measured under ASTM D 1777;
3. A minimum tensile strength of 108 X 36 lbs/ft (1580 X 525 N/m), measured under ASTM D 1682;
4. Maximum elongation¹ of 150 percent by 100 percent, measured under ASTM D 1682;
5. Calculated² minimum porosity of 85 percent;
6. Resiliency³, measured under ASTM D 1777 of 80 percent;
7. Ultraviolet⁴ stability measured under ASTM D 4355, of 80 percent.

Notes:

- ¹ Values for both machine and cross machine directions under dry or saturated conditions. Machine direction specimen for 2-inch (50 mm) strip test includes one machine direction polyolefin stitch line centered within its width and extending the full length of the specimen.
- ² Calculation based upon weight, thickness, and specific gravity.
- ³ The percent of original thickness retained after 3 cycles of a 100 psi (690 kPa) load for 60 seconds followed by 60 seconds without load. Thickness measured 30 minutes after load removed.
- ⁴ Tensile strength retained after 1,000 hours in an Xenon ARC weatherometer.

713.12.8 Turf Reinforcement Mat. Furnish a web of mechanically or melt bonded polymer netting, monofilaments, or fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion, or the placement of fibers between 2 high-strength, biaxially oriented nets mechanically bound together by parallel stitching with polyolefin thread. The mat must be resistant to biological, chemical, and ultra-violet degradation and meet the following:

1. Black in color;
2. Minimum mat thickness of 0.50-inch (13 mm), measured under ASTM D 1777;
3. Minimum tensile strength¹ of 94 X 54 lb/ft (1370 X 790 N/m), measured under ASTM D 1682;
4. Maximum elongation¹ of 75 percent by 75 percent, measured under ASTM D 1682;
5. Minimum calculated² porosity of 90 percent;

6. Resiliency³ of 80 percent, measured under ASTM D 1777;
7. Ultraviolet stability⁴ of 80 percent, measured under ASTM D 4355.

Note:

- ¹ Values for both machine and cross machine directions under dry or saturated conditions using 2-inch (50 mm) strip method.
- ² Calculation based upon weight, thickness, and specific gravity.
- ³ The percent of original thickness retained after 3 cycles of a 100 psi (690 kPa) load for 60 seconds followed by 60 second without load. Thickness measured 30 minutes after load removed.
- ⁴ Tensile strength retained after 1,000 hours in an Xenon ARC weatherometer.

713.13 GEOSYNTHETICS. Furnish geosynthetics meeting the requirements in Table 713-1 and the Contract. Store and protect the material following the manufacturer's recommendations. Any material left exposed to the sun 10 days or longer cannot be used in the work.

**TABLE 713-1
GEOTEXTILES & GEOMEMBRANES
GEOTEXTILES**

PROPERTY	TEST METHOD	DRAINAGE		EROSION CONTROL		SEPARATION / STABILIZATION		SEDIMENT CONTROL	PAVING	LIQUID/VAPOR BARRIER	
		LIGHT	HEAVY	CL I	CL II&III	MEDIUM SURVIVABILITY	HIGH SURVIVABILITY			LIGHT	HEAVY
Grab Strength (lbs.)	ASTM D 4632	80	180	90	200	180/115 **	270/180 **	90	80	—	—
Grab Elong %	ASTM D 4632	—	—	15	15	<50%/≥50% **	<50%/≥50% **	50% Max @ 45 lbs.	50% @ Break	—	—
Puncture 60 (lbs.)	ASTM D 4833	25	80	40	80	70/40 **	100/75 **	—	—	30 ***	60 ***
Trap Tear (lbs.)	ASTM D 4533	25	50	30	50	70/40 **	100/75 **	—	—	—	—
App. Opening Size (Sieve Size)	ASTM D 4751	50 Max.	30 Max	40 Max	40 Max	40 Max	40 Max	20 Max	—	—	—
Flow Gas/Min/Ft²	ASTMD 4491 (MOD.)	80	80	70	25	*	*	15	—	0.0	0.0
Ultraviolet Deg. 70% Ret. Strength	ASTM D 4355	150 Hrs	150 Hrs	150 Hrs	150 Hrs	150 Hrs	150 Hrs	500 Hrs	—	—	—
Melting Point (Deg. F)	ASTM D 276	—	—	—	—	—	—	—	300	—	—
Asphalt Ret. (Gal/Yd²)	AASHTO M 288	—	—	—	—	—	—	—	0.2	—	—
Thickness Mills (1 mm=40 mils)	ASTMD 3765 (MOD.)	—	—	—	—	—	—	—	—	30	60

GEOMEMBRANES

NOTES (TABLE 713-1):

ACCEPTANCE All values are minimum roll average values. Acceptance will be in accordance with ASTM D 4759.

DRAINAGE Light - use for sandy to clayey soils.
Heavy - use for coarse sands and gravels.

* **FLOW** Flow rates will be specified in the Special Provisions.

** **SEPARATION/STABILIZATION** Geotextiles with <50% elongation require the higher grab, puncture and trap tear strength values.

*** **GEOMEMBRANE** Test method for puncture will be in accordance with FTMS 101C-Method 2065.

**TABLE 713-1 Metric
GEOTEXTILES & GEOMEMBRANES**

PROPERTY	TEST METHOD	GEOTEXTILES				GEOMEMBRANES			
		DRAINAGE		EROSION CONTROL		SEPARATION / STABILIZATION		PAVING	LIQUID/VAPOR BARRIER
		LIGHT	HEAVY	CL I	CL II&III	MEDIUM SURVIVABILITY	HIGH SURVIVABILITY		
Grab Strength (kg)	ASTM D 4632	36.3	81.7	40.9	90.8	81.7/82.2 **	122.6/81.7 **	36.3	—
Grab Elong %	ASTM D 4632	—	—	15	15	<50%/≥50% **	<50%/≥50% **	50% @ Break	—
Puncture (kg)	ASTM D 4833	11.3	36.3	18.2	36.3	31.8/18.2 **	45.4/34 **	—	13.6 ***
Trap Tear (kg)	ASTM D 4533	11.3	22.7	13.6	22.7	31.8/18.2 **	45.4/34 **	—	—
App. Opening Size (Sieve Size)	ASTM D 4751	50 Max.	30 Max	40 Max	40 Max	40 Max	40 Max	—	—
Flow L/Min/m²	ASTM D 4491 (MOD.)	3256	3256	2849	1017	*	*	—	0.0
Ultraviolet Deg. 70% Ret. Strength	ASTM D 4355	150 Hrs	150 Hrs	150 Hrs	150 Hrs	150 Hrs	150 Hrs	—	—
Melting Point (Deg. C)	ASTM D 276	—	—	—	—	—	—	148.8	—
Asphalt Ret. (L/m²)	AASHTO M 288	—	—	—	—	—	—	0.9	—
Thickness mm (1 mm=40 mils)	ASTM D 3765 (MOD.)	—	—	—	—	—	—	—	1.5

NOTES (TABLE 713-1 Metric):

ACCEPTANCE All values are minimum roll average values. Acceptance will be in accordance with ASTM D 4759.

DRAINAGE Light - use for sandy to clayey soils.
Heavy - use for coarse sands and gravels.

* **FLOW** Flow rates will be specified in the Special Provisions.

** **SEPARATION/STABILIZATION** Geotextiles with <50% elongation require the higher grab, puncture and trap tear strength values.

*** **GEOMEMBRANE** Test method for puncture will be in accordance with FTMS 101C-Method 2065.